

Appln No. 10/672,186
Amdt date April 2, 2010
Reply to Office action of February 2, 2010

REMARKS/ARGUMENTS

A Final Office action was issued on February 2, 2010 in relation to the above referenced application. The Final Office action contains the following rejections:

- claims 1-6 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Pat. Publ. No. 2001/0018759 to Andreev et al. ("Andreev") in view of U.S. Pat. No. 5,742,510 to Rostoker et al. ("Rostoker").

Claims 1, 3, and 4 are pending. Reconsideration and reexamination are respectfully requested. The Examiner is thanked for attention to the application.

Applicant would like to thank the Examiner for his thorough discussion of the arguments in the Office action. It is only because of this thorough level of detail that Applicant has been able to understand the subtle differences of understanding between the Examiner and Applicant. It seems that there are places where the Applicant or the Examiner has misunderstood the other and Applicant hopes that the following discussion clarifies the situation.

There seem to be three main areas where it appears the present invention and Applicant's previous submissions have been misunderstood.

- (i) Andreev does not disclose a method for routing all connections independently and in parallel.
- (ii) Examiner appears to attach great importance to the question of "simultaneity", however it is submitted that simultaneity is not an essential feature of the present invention. Furthermore, Applicant agrees with the Examiner that "independent and in parallel" does not necessarily imply "simultaneous".
- (iii) Two connections which must be routed serially, and where the routing of the second depends on the routing of the first, cannot be said to be routable 'in parallel' and are not 'independent'.

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Applicant agrees that *if* Andreev's algorithm could route connections independently and in parallel *then* with teachings from Rostoker it could be made (potentially) simultaneous too. However, since Andreev's algorithm can only route connections substantially independently and substantially in parallel, the teachings from Rostoker only allow it to be made substantially (potentially) simultaneous.

Each of the three points above are considered in detail as follows.

(i)

The first paragraph of "5a)" on pages 2-3 contains two sentences which appear to contradict one another. Applicant thought at first that this was just a small error or even a typo, but it seems to reflect a fundamental misunderstanding of the Andreev patent, and this is repeated several times later in the communication.

The first sentence says:

“... Andreev et al. clearly show and disclose, a ... method of determining the routing ...
the method comprising: routing all connections independently and in parallel ...”

But this is not the case. The critical word is the word 'all'. Andreev only shows how to route *most* connections independently, not *all* connections. Any two connections which don't overlap can be routed independently, but any two which overlap have to be routed one at a time (i.e., not in parallel), and the routing chosen for the earlier connection affects the routing of the later connection (in other words, the routing of the second connection *depends* on the routing chosen for the first connection, and the connections are therefore dependent, not independent).

Applicant agrees with the second sentence which says:

“However, Andreev et al. does not specifically disclose routing all connections independently and in parallel ...”

This is correct. In fact, as Applicant has explained before, Andreev's algorithm cannot be adapted to route all connections independently, since it mixes the routing of a connection with

the updating of the corresponding capacities, which in turn affects subsequent routing. In particular, Andreev cannot be combined with Rostoker to produce an algorithm which routes all connections simultaneously. (Assuming arguendo that Andreev could be combined with Rostoker, it could only be combined with Rostoker to produce an algorithm which routes all non-overlapping connections simultaneously, but that is quite different and is nothing like the present invention.)

The assertion in the first sentence is repeated in other parts of the communication. For example, on page 4 in section b), the communication claims that:

- “... Andreev et al. as modified by Rostoker et al. clearly show and disclose ... the steps of:
- (a) defining ... routing ... respecting only those crossing conflicts ... which have been explicitly registered with the set currently being considered ... ;
 - (b) examining connections ... ;
 - (c) collating all such proposed routing and resolving any crossing conflicts ... in a symmetric manner ... ”

But Andreev's algorithm, whether modified by teachings from the Rostoker patent or not, does not collate *all* such proposed routing, because it has to deal separately and serially with connections which overlap.

(This short extract also attempts to clear up a couple of less important misunderstandings. Andreev's algorithm appears to respect edge capacities, which could be construed to be an equivalent to the crossing conflicts discussed in the present application, since these are held on the edges which the routing is trying to cross; but the algorithm of the present invention notices only those conflicts which have been explicitly registered with the connections being routed. Furthermore, Andreev's algorithm does not generate 'crossing conflicts', and does not resolve crossings in a symmetric manner, since connections considered serially are not considered symmetrically.)

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On page 7, lines 3 and 4, the communication states:

“Andreev clearly discloses the routing occurs independently and in parallel. The routing of Andreev considers the routes individually (independently), at the same time (in parallel).”

Applicant thought at first that this was the same misunderstanding, but it appears from the start of this paragraph that 'the routing' in these sentences refers only to that routing which Andreev can perform in parallel. Applicant submits that while it may be possible that Andreev's algorithm can route non-overlapping connections independently and in parallel; the critical point is that Andreev cannot route all connections independently and in parallel. Andreev can only route some of the connections independently, and this can be made simultaneous from teachings in Rostoker, but this is irrelevant to the present invention.

(In addition, the phrase “individually (independently)”, seems to imply that these two terms are somehow synonyms. But a normal serial router considers connections individually but not independently: it looks at connections one at a time and the routing of later connections depends on the routing chosen for earlier connections. Applicant therefore does not understand the juxtaposition of these two words in this context.)

Page 8 line 3 says:

“Further, Andreev clearly discloses routing all connections independently and in parallel (... abstract ...)”

Again, Applicant respectfully disagrees. Andreev specifically excludes (Andreev [0216] and following, as Applicant discussed in section (1) of Applicant's Amendment dated November 20, 2007) overlapping pairs of connections, and appears to only route some connections substantially independently and substantially in parallel. Examiner cites Andreev's abstract as support for this claim, but the abstract includes the word 'substantially'. This is a crucial distinction between Andreev and the present invention.

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Page 10 line 5 says:

“Andreev clearly discloses routing all connections in parallel and independently, however, as Applicant has indicated not fully simultaneously.”

Applicant submits that the first part is false, but the second part is true. Applicant has indeed pointed out that Andreev cannot route all nets fully simultaneously; but this is because Andreev does not (and cannot be modified to) route all nets in parallel, or independently, and therefore making the independent and parallel bits of the Andreev algorithm simultaneous does not lead to 'fully simultaneous' routing. Andreev and Rostoker combined, while not conceding that they are properly combinable, cannot provide an algorithm which routes connections 'fully simultaneously' not because of the word 'simultaneously' but because of the word 'fully'.

Page 12, line 8, says:

“... Andreev clearly discloses the routing of interconnected regions independently, in parallel, and substantially simultaneously ...”

Applicant submits that this is only partly correct: in fact, Andreev discloses the routing of interconnected regions, however it cannot route overlapping nets in parallel or independently (see, for example, Andreev [0216]). Using the teachings of Rostoker to make simultaneous the parts of the Andreev algorithm which can be made simultaneous does not make the whole Andreev algorithm simultaneous, of course; it cannot affect the parts of the Andreev algorithm which cannot be made simultaneous (such as the serial processing of overlapping connections).

(ii)

Simultaneity is not essential to the present invention. Applicant submits that not all connections can be routed independently and in parallel by Andreev, and therefore all connections cannot be routed simultaneously by combining the teachings of Andreev and Rostoker.

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Also, Applicant has never submitted that an algorithm capable of routing connections independently and in parallel must necessarily route then simultaneously. It is however true that an algorithm capable of routing connections independently and in parallel is by definition capable of routing them simultaneously. The communication says, in the longest paragraph on page 9:

“During the interview to which the Applicant is referring (19SEP2008), ... Applicant argued that independently and [in] parallel necessarily included simultaneous.”

With respect Applicant did not argue this; in fact Applicant said, in as many words, that Applicant was not attempting to take out a patent which merely covered a routing algorithm where all nets were routed simultaneously. This is undesirable for several reasons: if there are more connections than processors, which is the case in virtually all practical applications of Applicant's algorithm, the connections generally cannot be routed simultaneously since each processor can generally only consider one connection at a time; and if a competitor were to implement Applicant's algorithm and use it in such a case, they could argue that their routing is not simultaneous and therefore does not infringe any future patent granted to Applicant.

What Applicant actually said was that two or more tasks which are mutually independent and can be performed in parallel can be done simultaneously. To put it in an equivalent (but inelegant) form, 'independently' and 'in parallel' implies 'potentially simultaneous' (not 'simultaneous'). This is true by definition. If two tasks can be run in parallel, parts of the processing required for the first task can be interleaved with parts of the processing required for the second task; and if they are independent, i.e. the processing and output of one task has no dependence on the processing or output of the other task, and vice versa, then the processing can happen not just interleaved but actually at the same time. Examples of such pairs of tasks are two non-overlapping connections in the Andreev algorithm, or any two connections in the algorithm of the present invention.

(iii)

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Page 8 line 5 and following says:

“When an overlap between regions occurs Andreev considers the routes with respect to one region then the other, ...”

which is true. But the communication goes on to say:

“... while still considered independently and in parallel they are not however considered simultaneously.”

Applicant respectfully does not understand these statements. Two connections which overlap are not considered in parallel by Andreev's algorithm: one must be fully routed before the other can be considered. They must be processed serially, not in parallel. Furthermore, any connections which get routed then affect the routing for any other connections routed later in the same region, since any routing updates edge capacities which in turn affect the algorithm's assessment of the 'best' routing for any subsequent connection.

Applicant can reduce this explanation to a simple form by the following worked example: Consider the tasks of routing two overlapping connections. As Examiner states, Andreev's algorithm considers these connections one at a time. It chooses one connection, say A, locks the region of the design in which A is to be routed, and starts doing the processing required to route it. While this is happening, no processing is possible on the second connection, say B, since the region required for routing B is locked by A. If A and B were in different parts of the board, teachings from Rostoker could be used to route A and B simultaneously; but B is locked out by A, and Rostoker's teachings are not relevant in this case, since Rostoker has nothing to say about the locking mechanism used by Andreev.

When Andreev's algorithm finishes routing A, it updates the capacities along the routing path it has chosen for A and then unlocks A's region of the board. Now B can be routed. Andreev's algorithm locks B's region of the board and starts considering the best routing for B. But this is in the context of the updated capacities, so the routing problem for B depends on the routing path chosen for A. In this way, B's routing will depend on A's routing, so these two tasks

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are not independent. This simple example shows that Andreev's routing is not fully independent and cannot be performed fully in parallel, and therefore that combining Rostoker's approach with this algorithm cannot make it fully simultaneous.

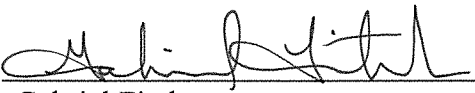
Consider the following more extreme example. Suppose the routing problem is to connect nets directly across a central point. Imagine a clock face; 12 must be connected to 6, 1 to 7, 2 to 8, etc. In fact, imagine an example where there are thousands of such nets instead of just six. When this routing problem is given to the Andreev algorithm, it picks one of the nets, locks its corresponding region of the board, and starts routing it. While this is happening, none of the other nets can be considered. Teachings from Rostoker cannot help, because they only apply to tasks which can be run in parallel. The other nets have to wait until the first net has finished and unlocks the common region of the board. A second net is then considered by the algorithm, but again this blocks the processing of all remaining nets. So in this case the Andreev algorithm is no faster than a normal serial router.

In contrast, the present invention is new and non-obvious because all connections are routed independently and in parallel, not just those connections whose regions don't overlap. Combining the teachings of the present invention with Rostoker might subsequently enable one skilled in the art to produce a routing algorithm which routed all connections independently, in parallel, and potentially simultaneously; but this cannot be achieved from the combination of Andreev and Rostoker absent the improper hindsight of Applicant's disclosure.

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For the aforementioned reasons, Applicant submits that all of the pending claims are allowable. Therefore, Applicant respectfully request a timely issuance of a Notice of Allowance. If Applicants' counsel can be of assistance, please do not hesitate to call the undersigned at the phone number provided below.

Respectfully submitted,
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